

# The Links Between Student Attitudes, Engagement, and Learning in Introductory Data Science Courses

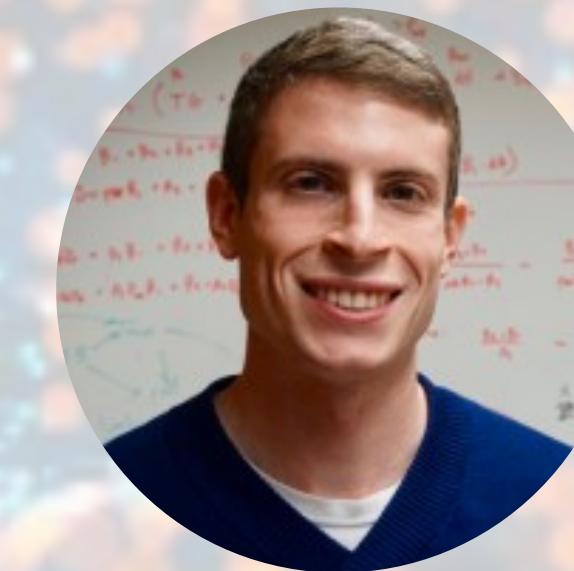
November 2nd, 2023



Hannah Lloyd



Erik Brockbank

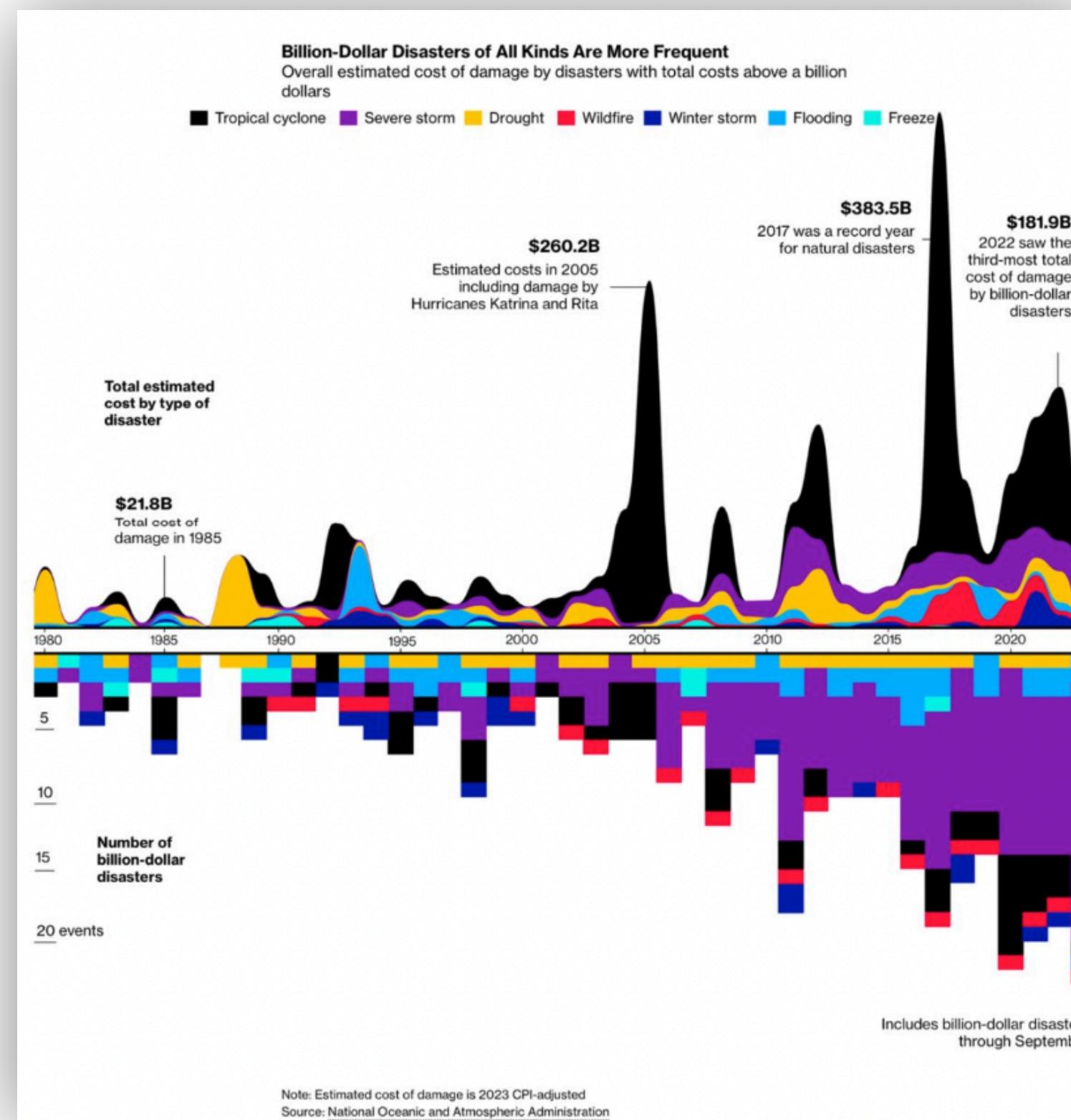


Adam Bear

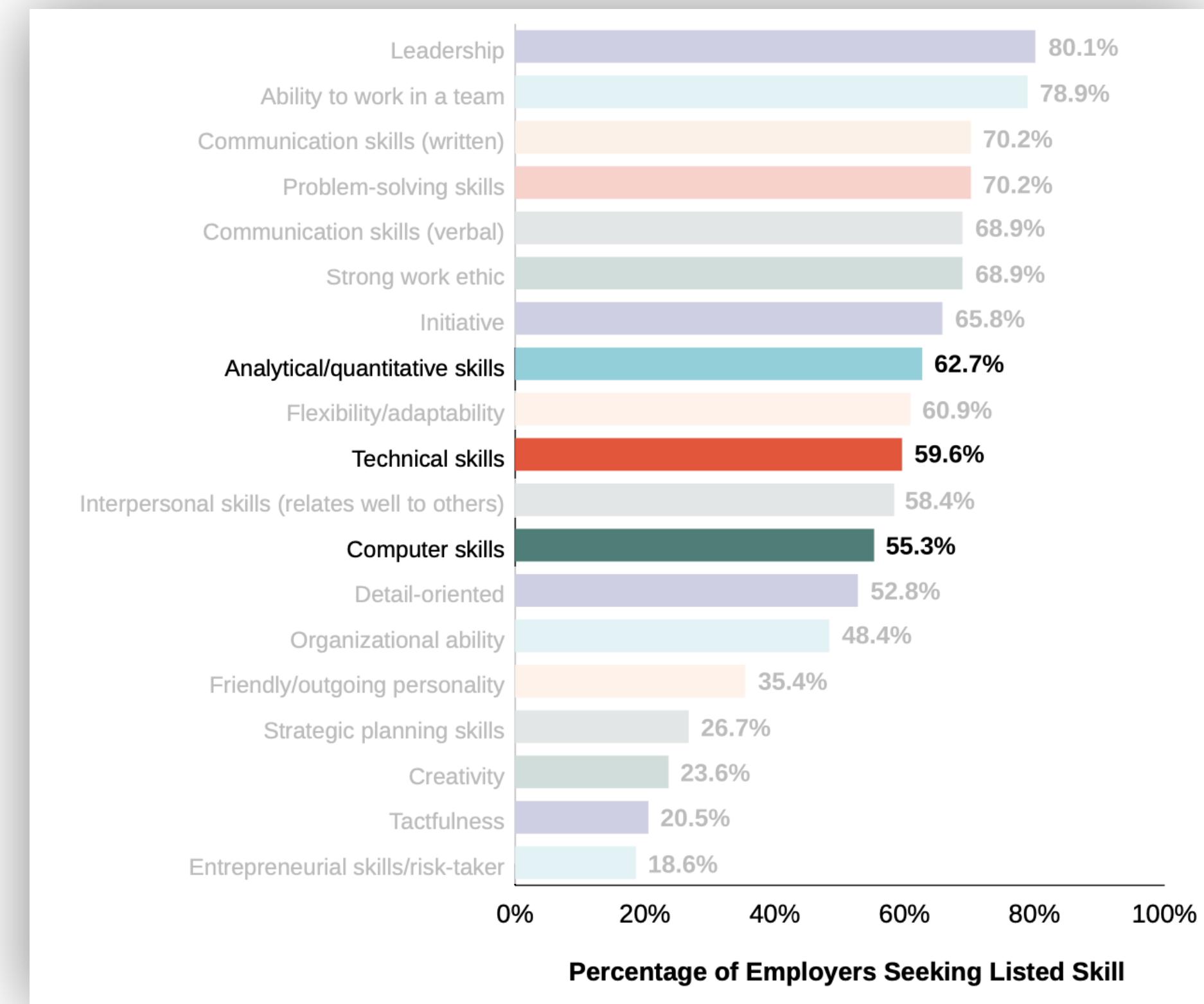


Judy Fan

# We live in a **complex** world filled with **large-scale** data



New York Times

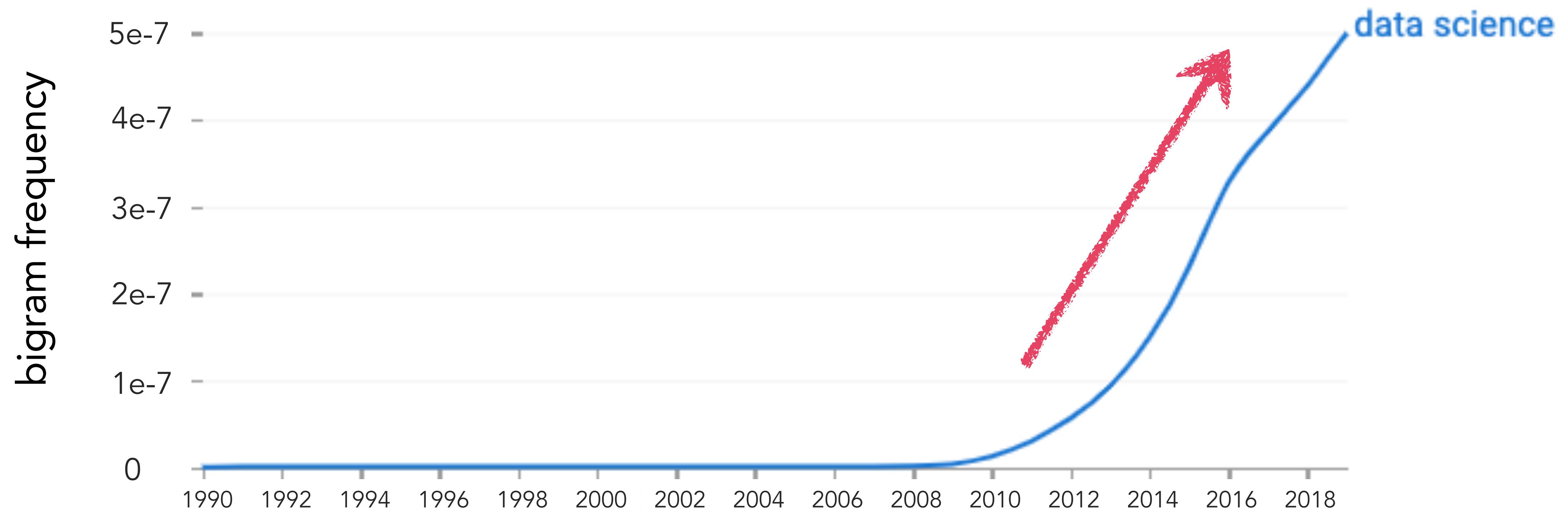


National Association of Colleges and Employers (NACE) Job Outlook 2016 Survey

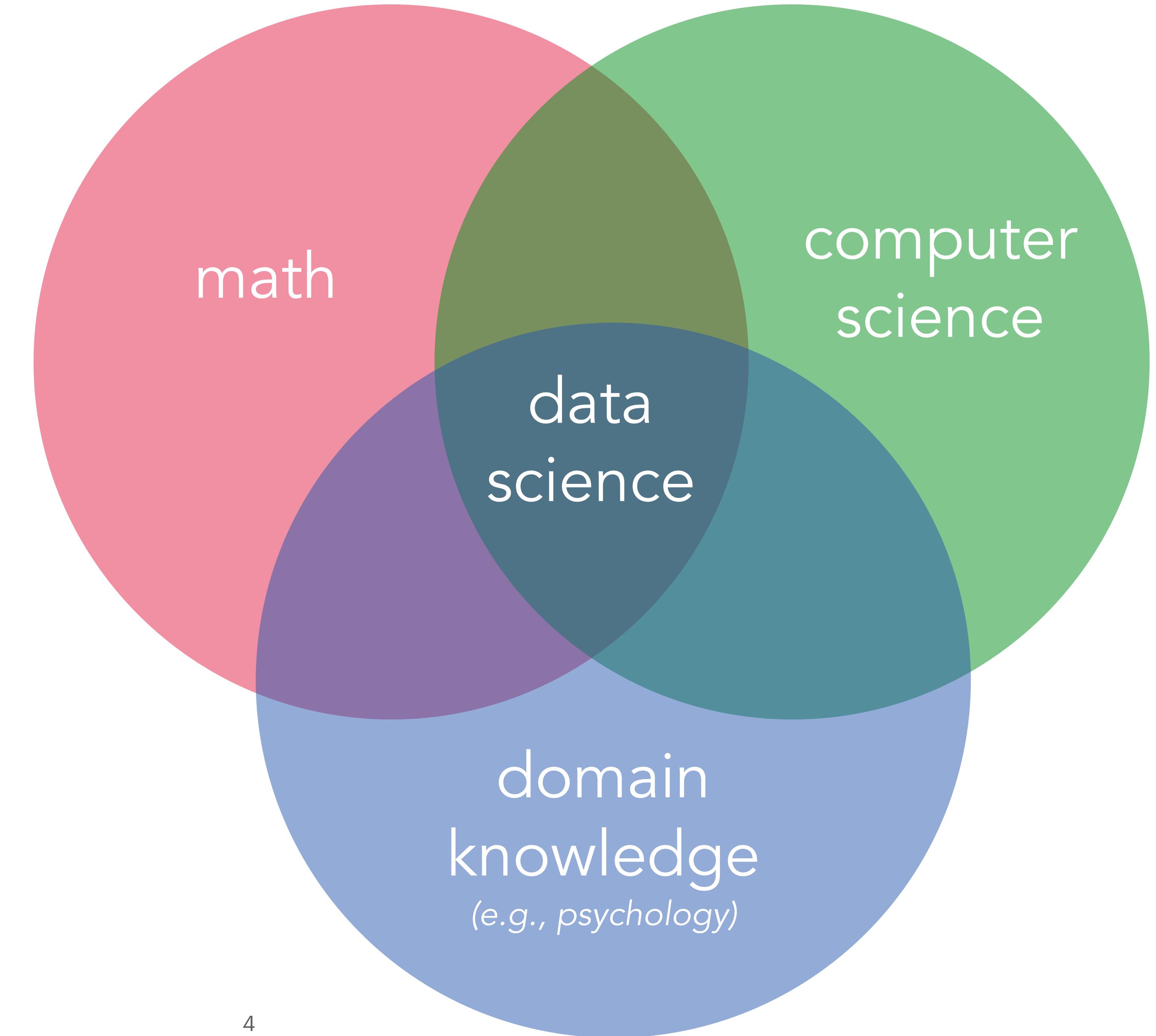
We **reason** with big data everyday

**Workforce** preparedness

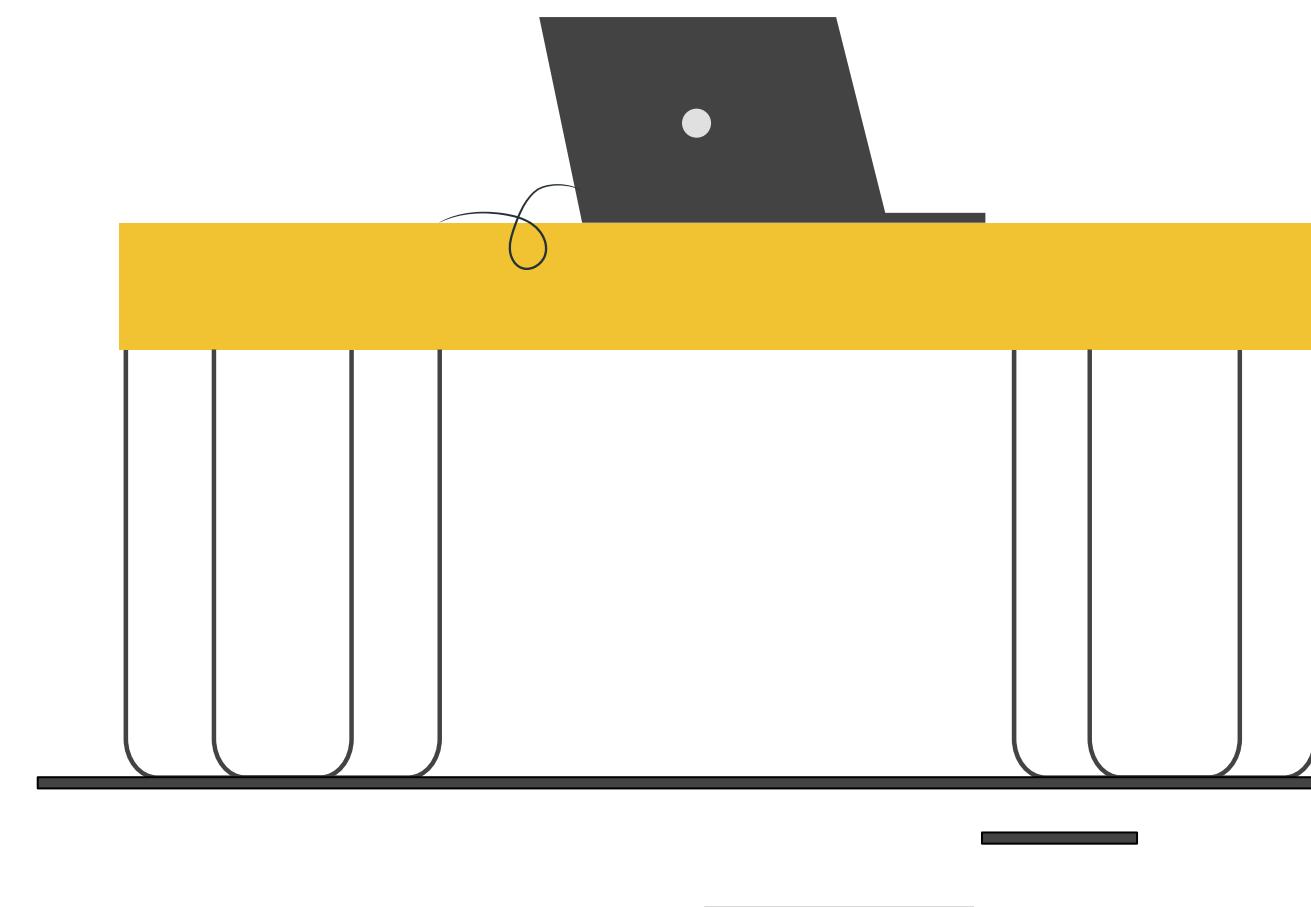
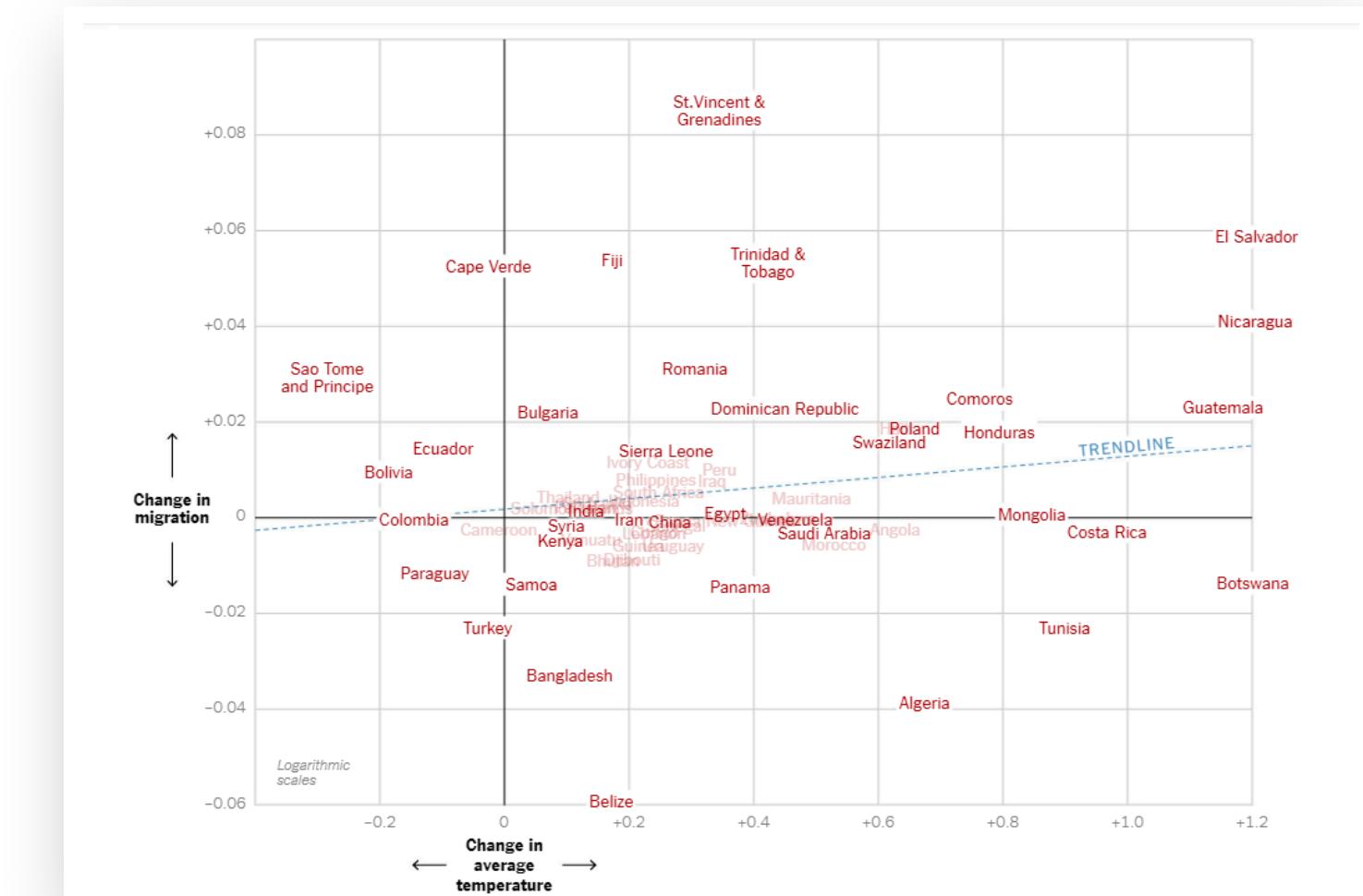
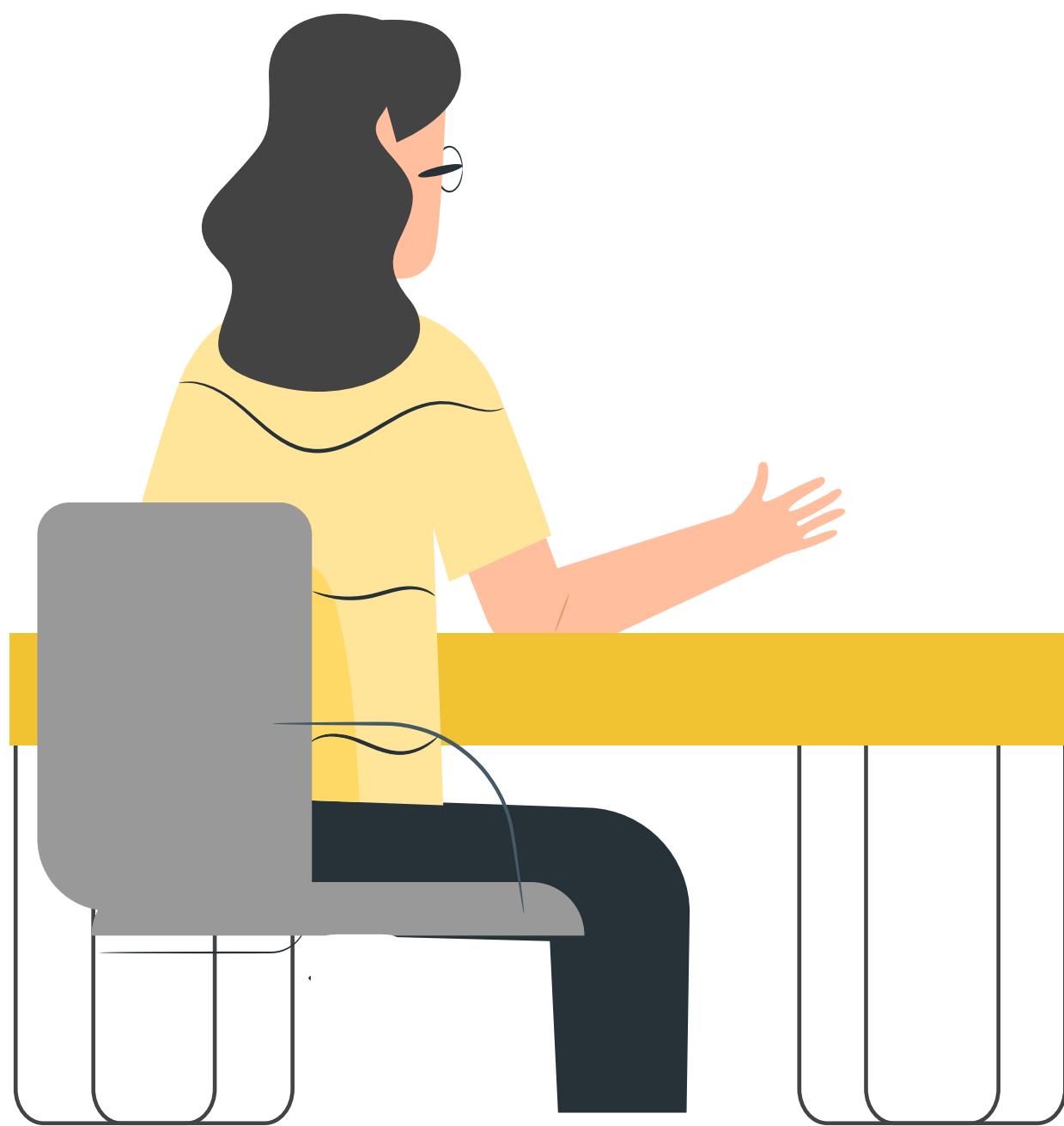
# Rapid and recent rise in prominence of **data science**

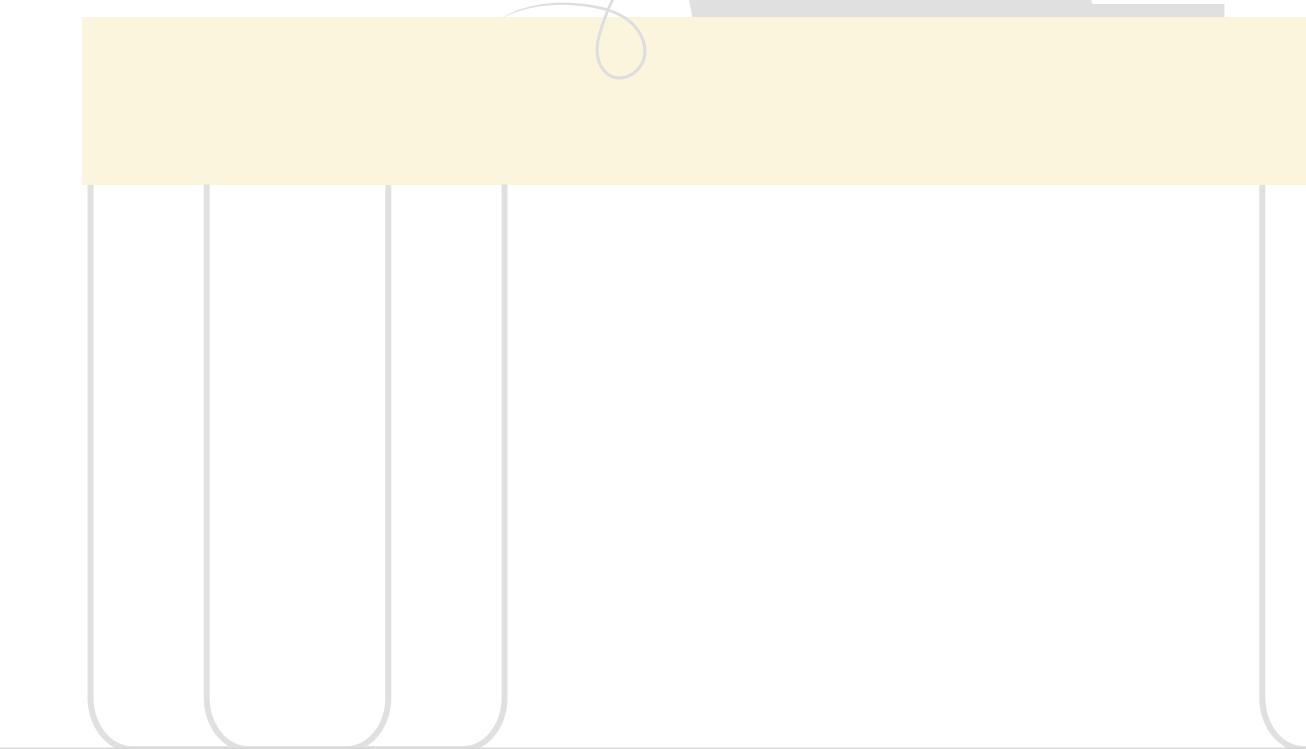
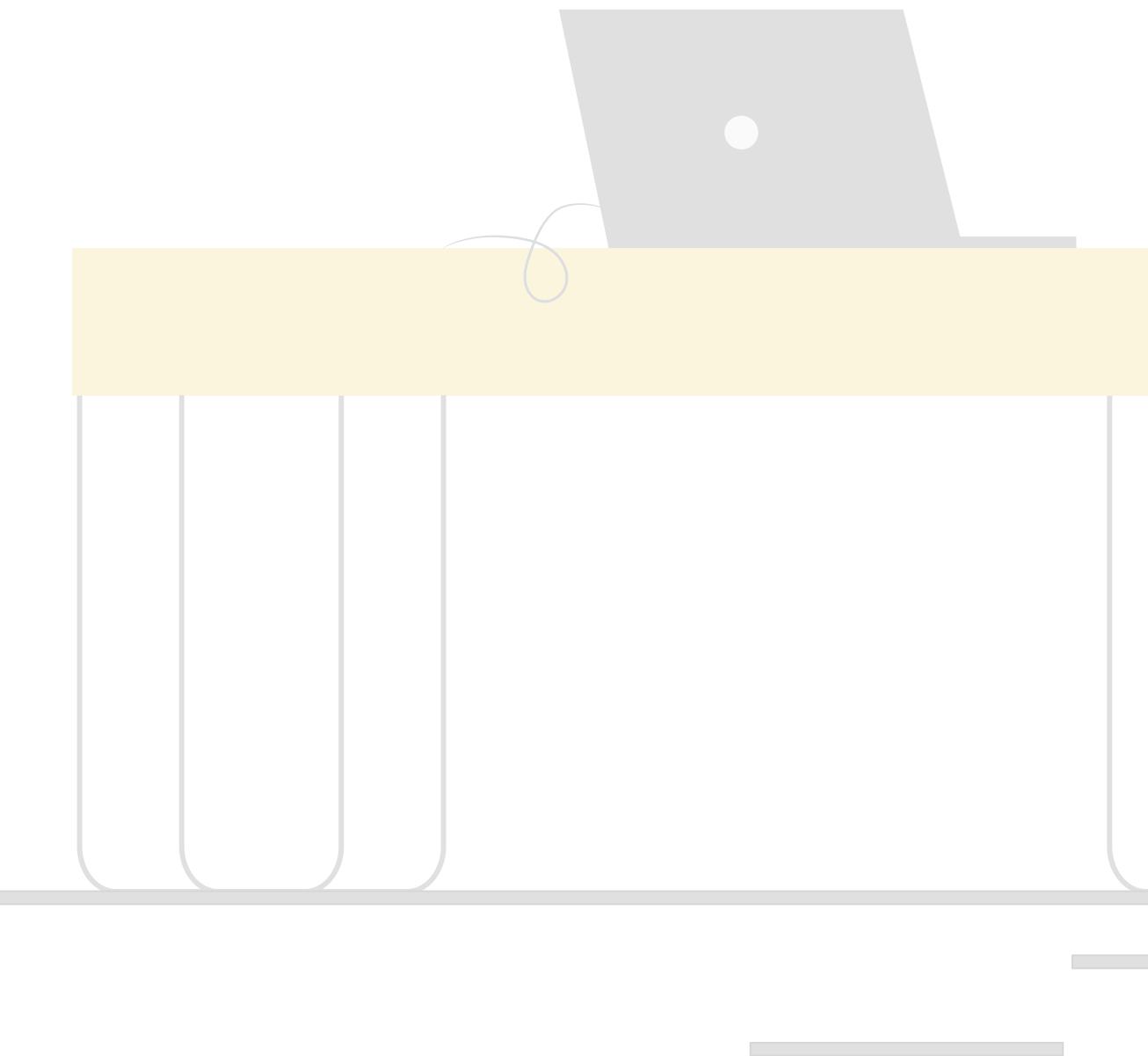
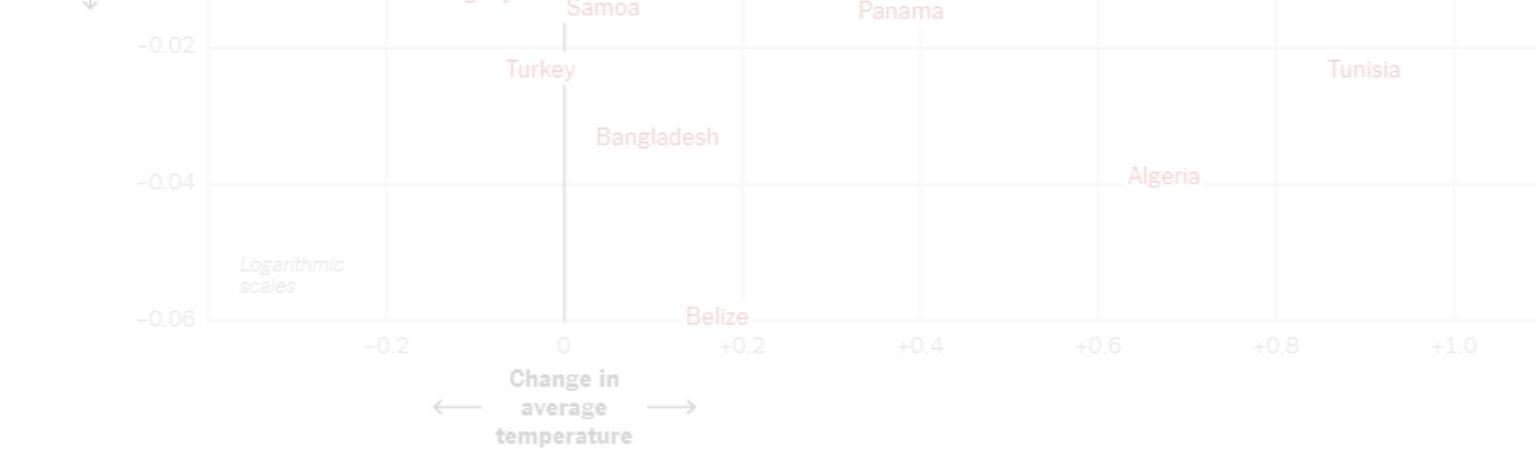
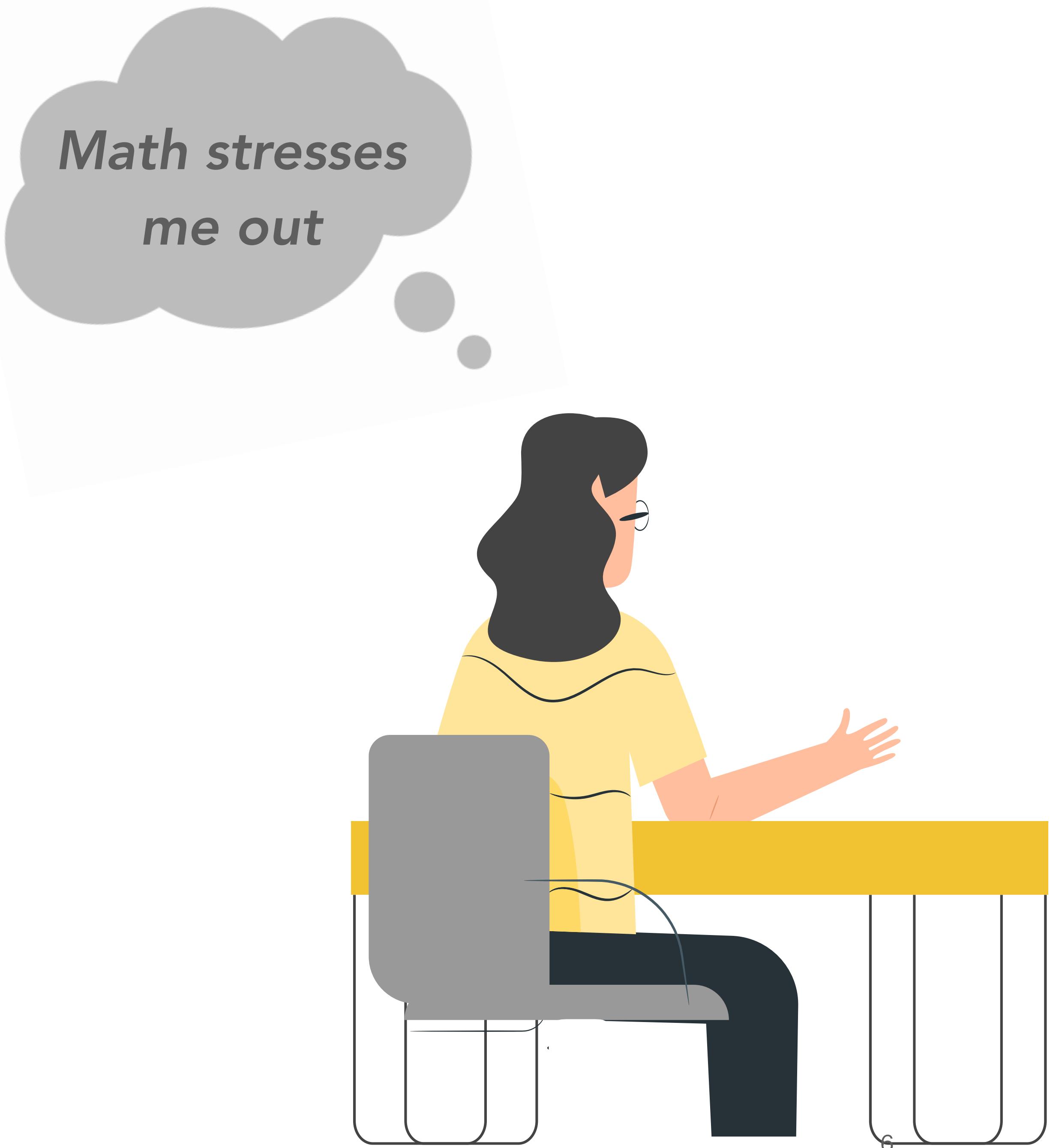


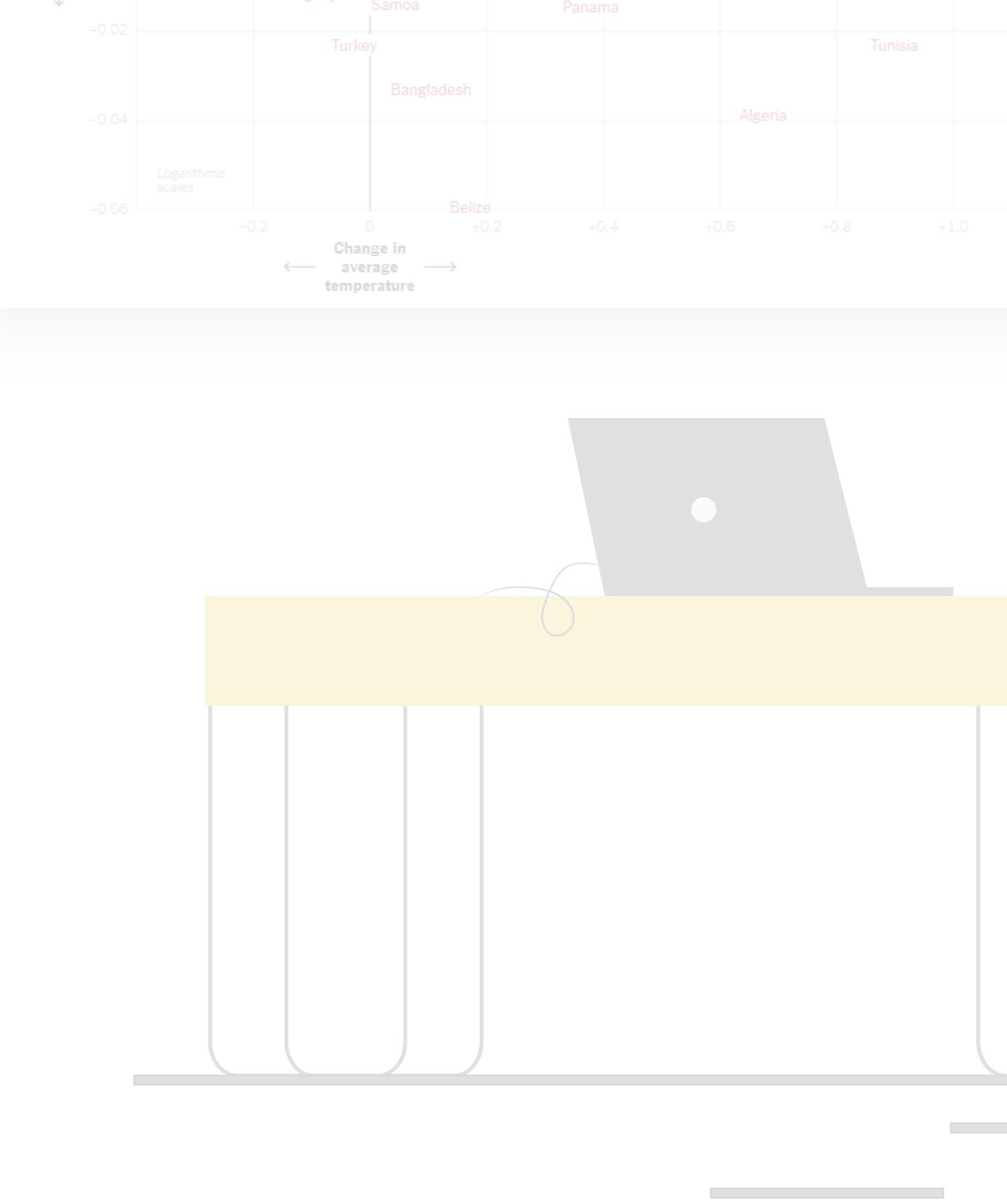
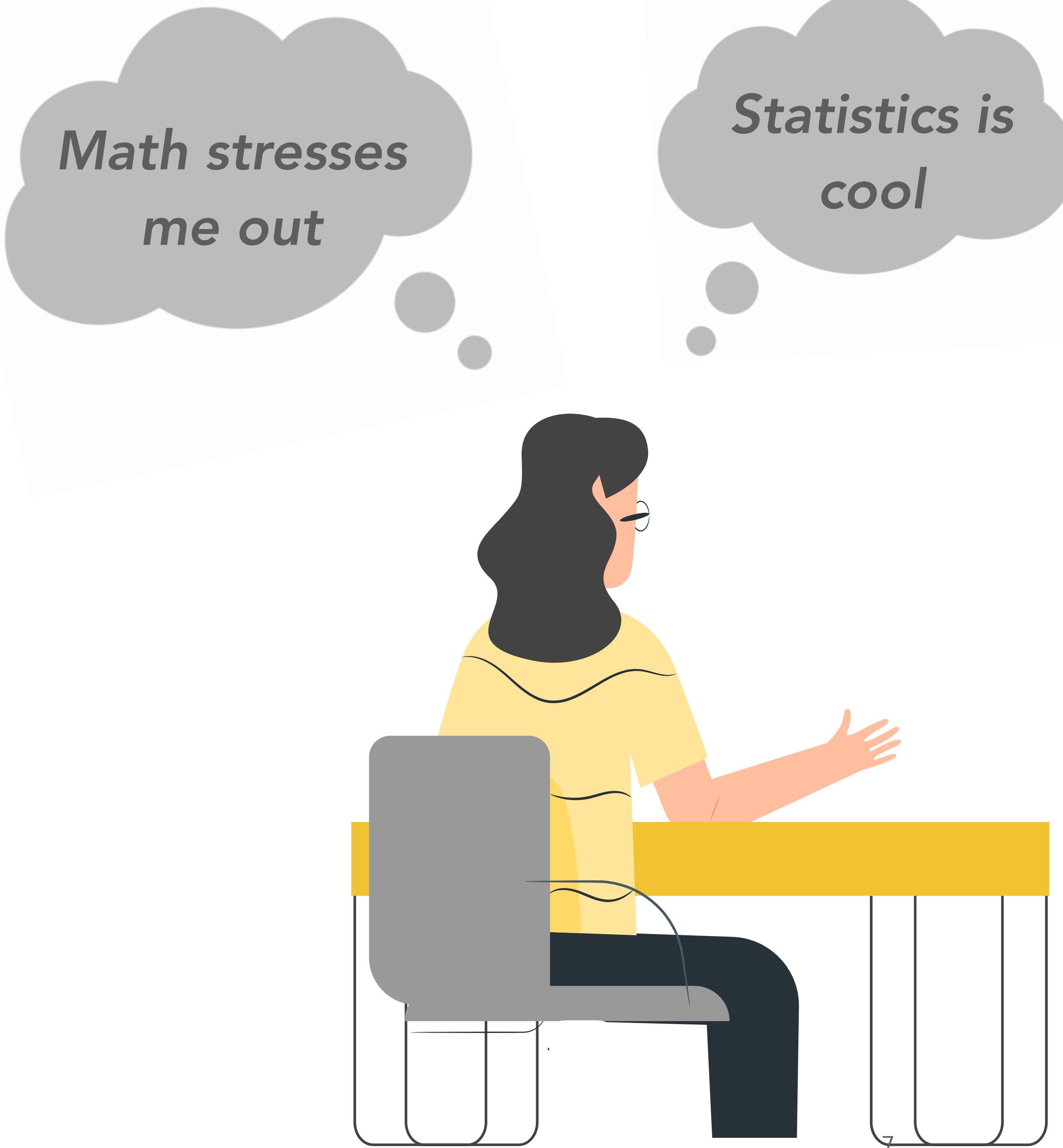
Multidisciplinarity  
of data science  
poses challenges  
for pedagogy

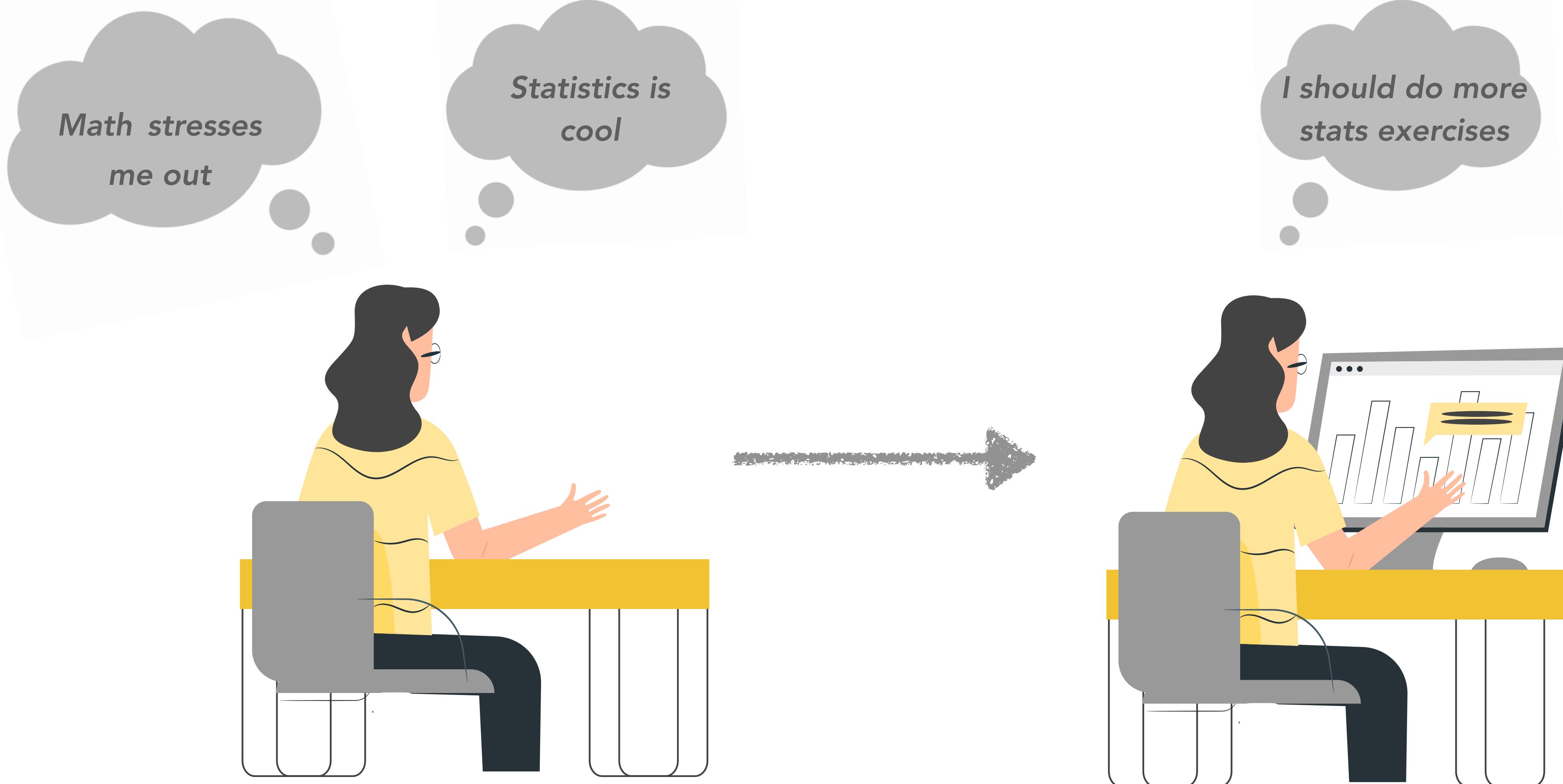


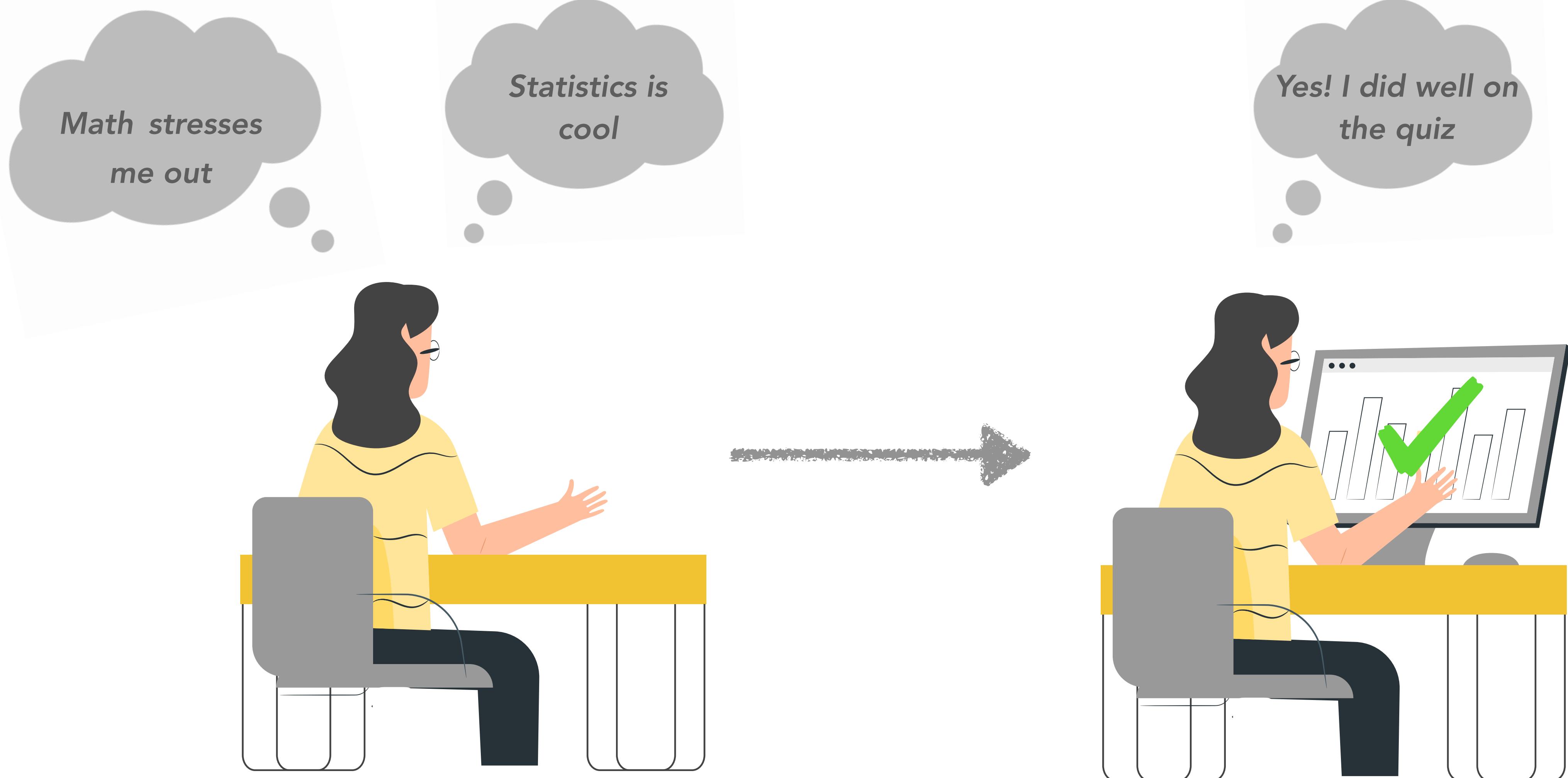
# What predicts learning in data science courses?



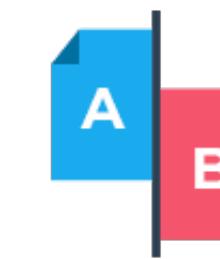








# Measuring student attitudes & behavior using

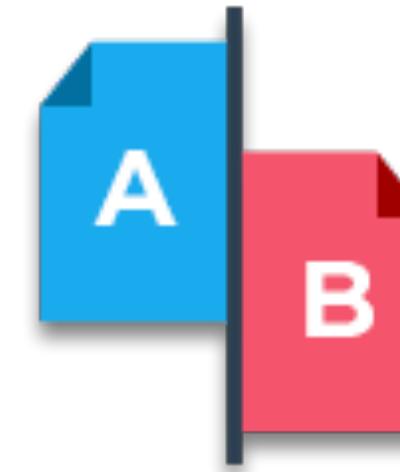


Course**Kata**



## CourseKata Statistics & Data Science

Welcome to *CourseKata Statistics and Data Science*, an innovative interactive online textbook for teaching introductory statistics and data science in colleges, universities, and high schools.



# CourseKata



high  
school

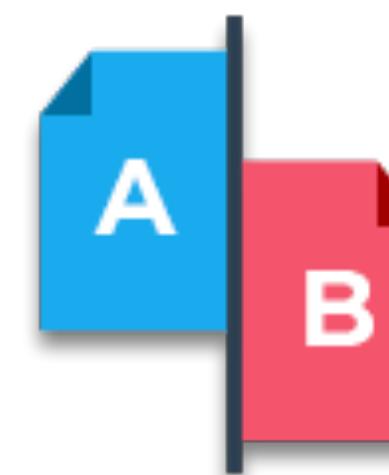


community  
college



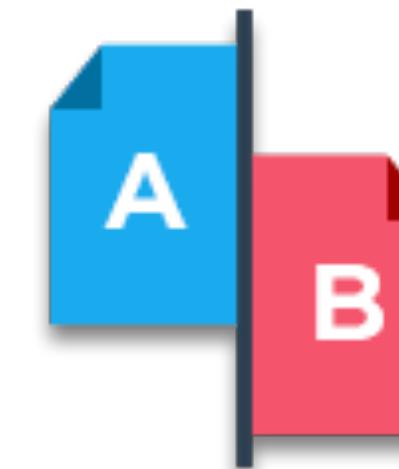
4-year  
college

*39 institutions*

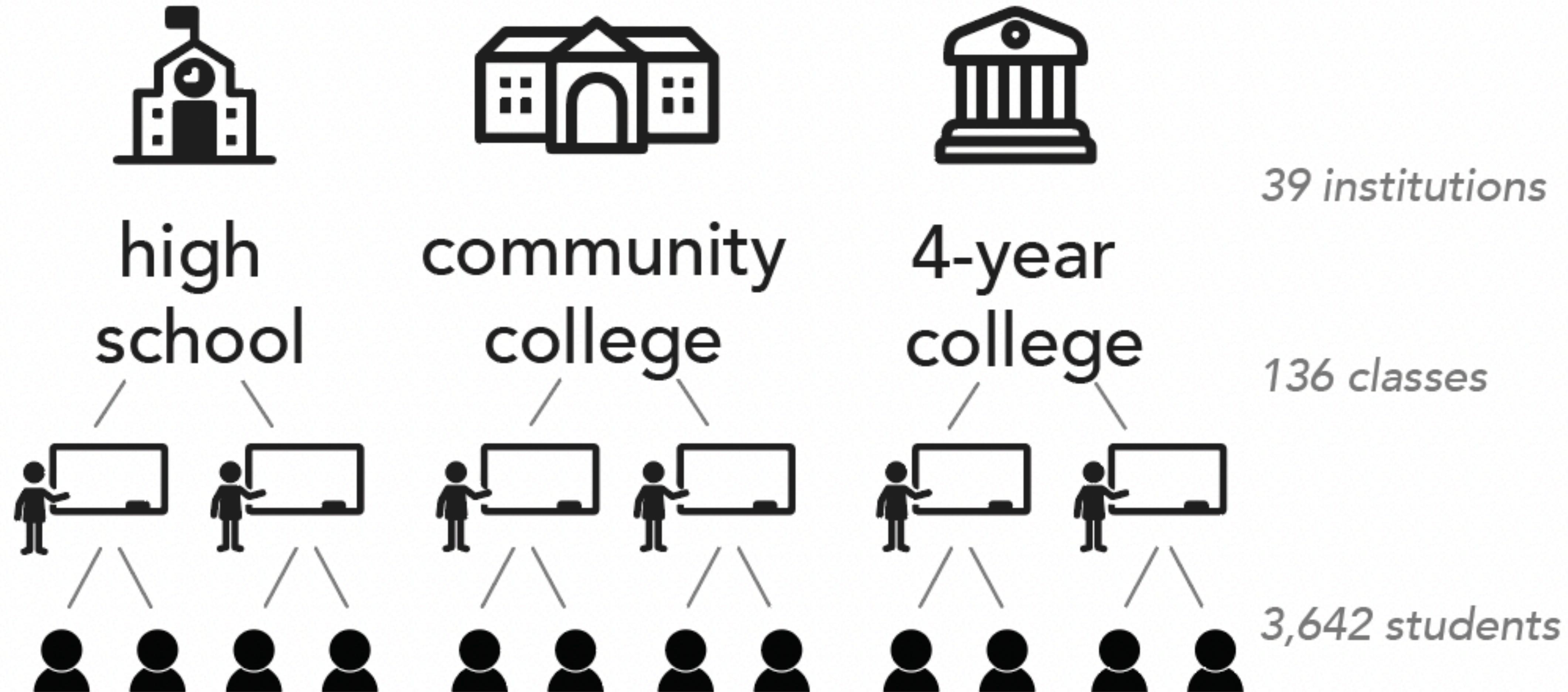


# CourseKata

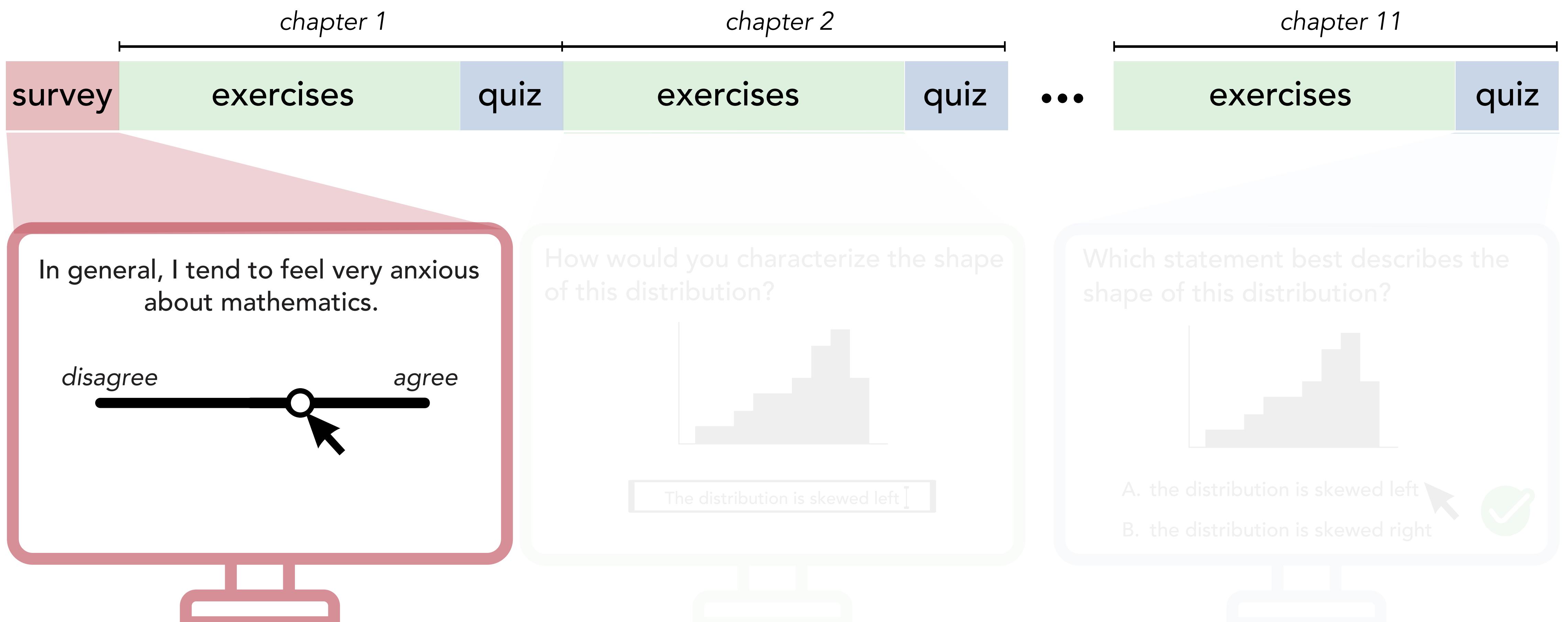




# CourseKata



# Measuring student attitudes & behavior using CourseKata



# Embedded surveys to measure student background & interests

The screenshot shows a survey interface. At the top, there's a dark header with three dots on the left. Below it, a light blue header bar displays the title "College / Statistics and Data Science (ABC)" in bold blue text. Underneath the title is a dropdown menu with "College / Statistics and Data Science (ABC)" selected. A small "Book" link is visible above the dropdown. The main content area has a white background. It starts with a section titled "Pre-Survey" in bold black text. Below it is a "Welcome to Statistics and Data Science!" message. A note states: "Completing this survey is a course requirement, but answers will not count as part of your grade. All individual answers will be kept confidential, although de-identified data might be discussed in class. (Estimated time: 10 minutes)". A yellow callout box contains a note: "NOTE: Be sure to scroll down and answer all questions for each item before clicking NEXT." At the bottom of the survey area, a progress bar shows "1 of 14". Below the progress bar, instructions say: "Please rate your level of agreement (or disagreement) with each of the following statements." A sample statement is shown: "I am confident I can learn the material in this course."

**Broad set of constructs:**

**math anxiety**

**level of interest**

**mindset** (fixed vs. growth)

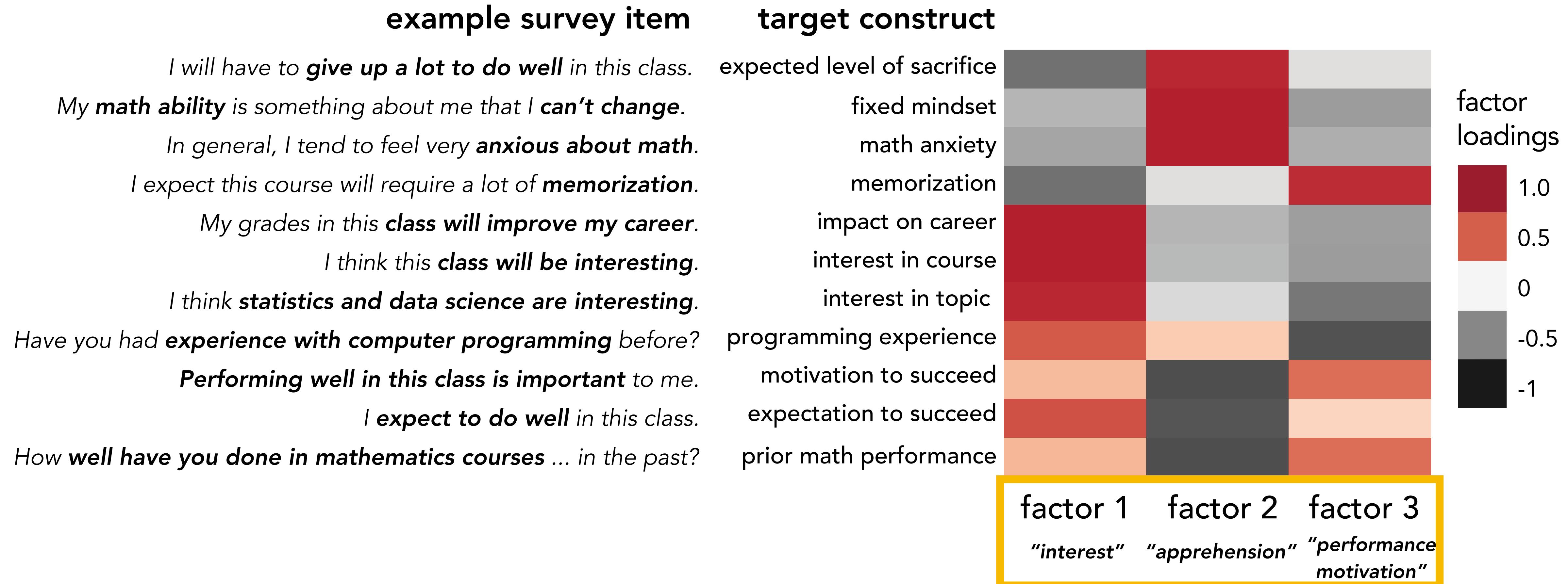
**confidence** (e.g., w/ programming)

**demographic variables**

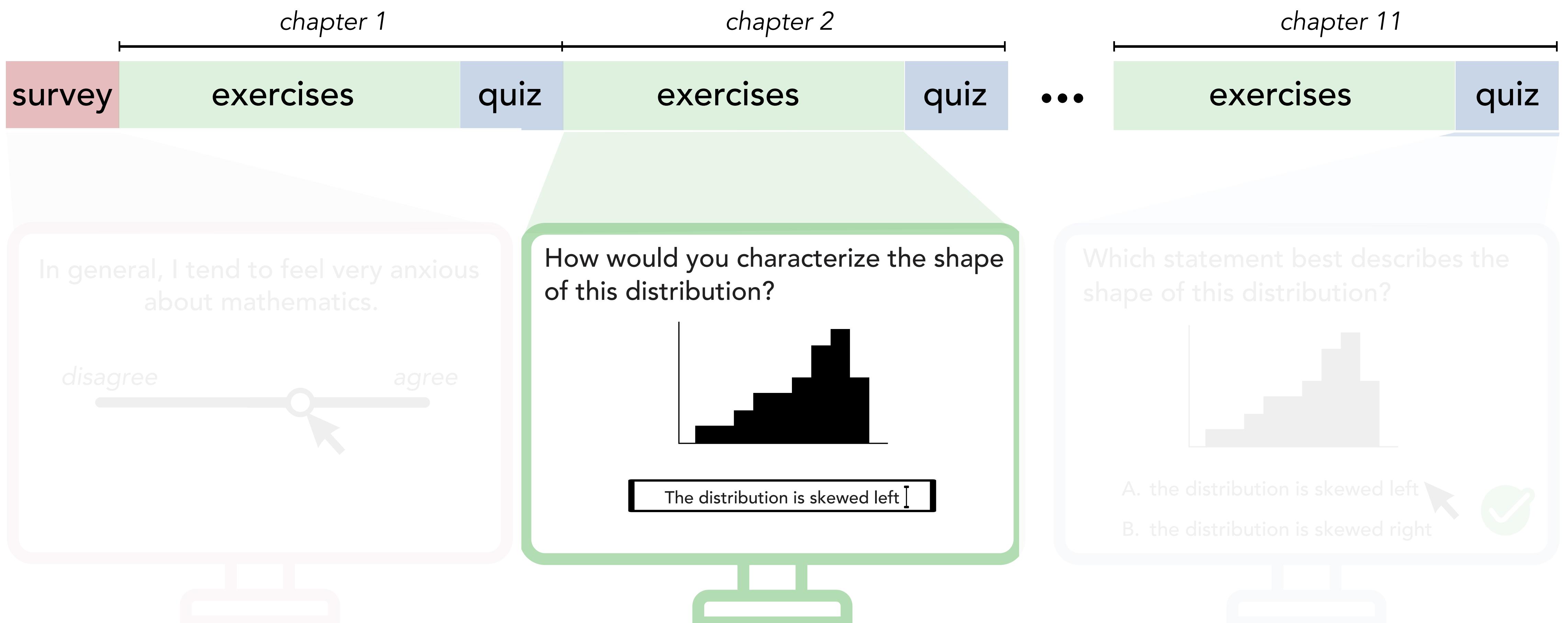
(e.g., SES, gender, race, edu background)

**& many more!**

# Principal Components Analysis for Survey Dimensionality Reduction



# Measuring student attitudes & behavior using CourseKata



# Learning activities interleaved with new material

Should be more continuously distributed, with most people having thumbs of average length, and then some a little longer and some a little shorter.

This is exactly what we mean when we say “look for weird things.” One possibility is that some of the students didn’t follow instructions, and measured their thumbs in centimeters (or maybe even inches) instead of millimeters. Given what we know about students, this seems like a reasonable theory; they don’t always listen to instructions.

**The point here, though, is this: if we hadn’t looked at the distribution, we would not have noticed this oddity and might have drawn some erroneous conclusions.**

If our theory is correct, that some students reported their thumb lengths in centimeters instead of millimeters, what kind of error would this be?

A	Mistake
B	Measurement error
C	Missing data
D	Natural variation (or fluctuation) in thumb length

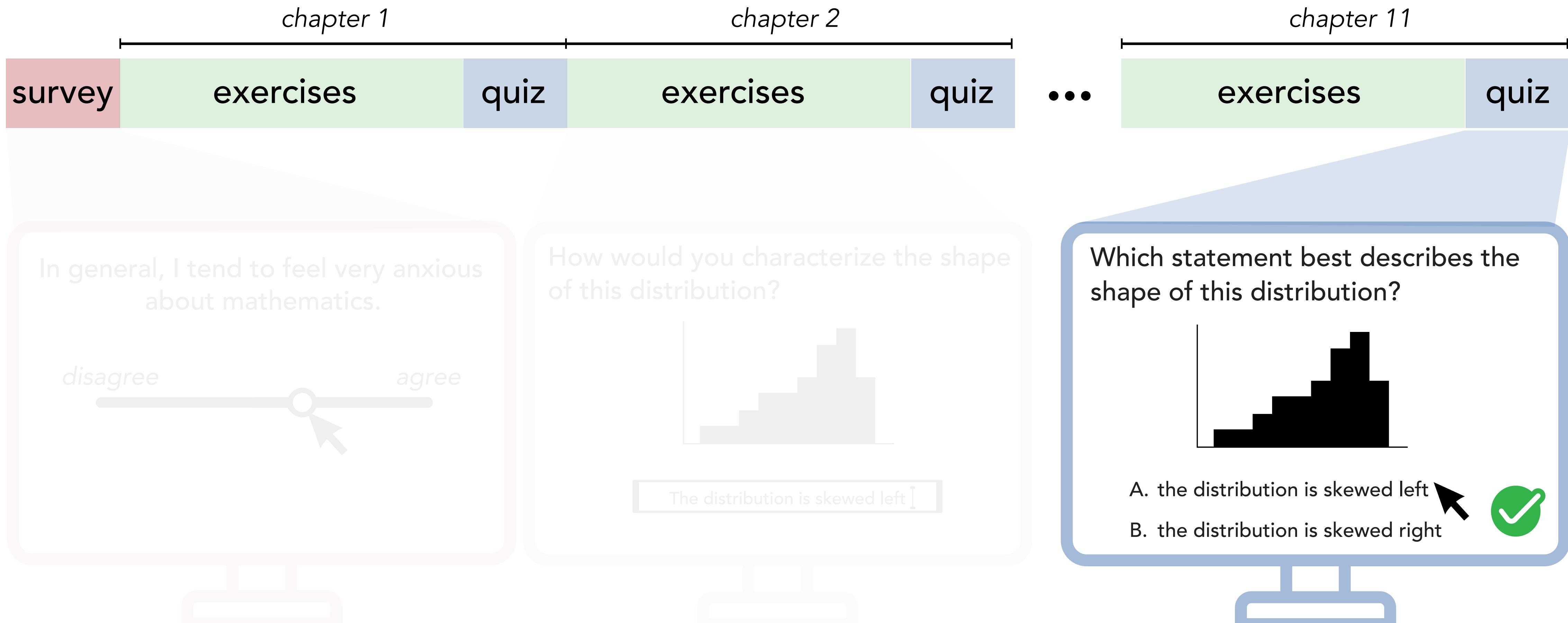
Learnosity: Ch3\_Shape\_2

Conceptual  
questions

Coding  
exercises

Open-ended  
responses

# Measuring student attitudes & behavior using CourseKata



# Interspersed assessments to test comprehension & generalization

The screenshot shows a digital assessment interface. At the top, there's a dark header bar with three dots. Below it, a navigation bar has a blue '≡' icon followed by the text 'College / Statistics and Data Science (ABC)'. Underneath, a 'Book' section shows 'College / Statistics and Data Science (ABC)' with a dropdown arrow. The main content area is titled '2.10 Chapter 2 Review Questions'. A question is displayed: '1. What's true about data?'. Four options are listed: A) They require that you've selected a sample., B) They are the result of measurement., C) They represent something about the world., and D) All of the above. The option 'B' is highlighted with a cursor. At the bottom left, it says 'Learnosity: A2\_Review1\_01'. The page number '20' is at the bottom center.



Conceptual questions  
appearing at the end  
of every chapter

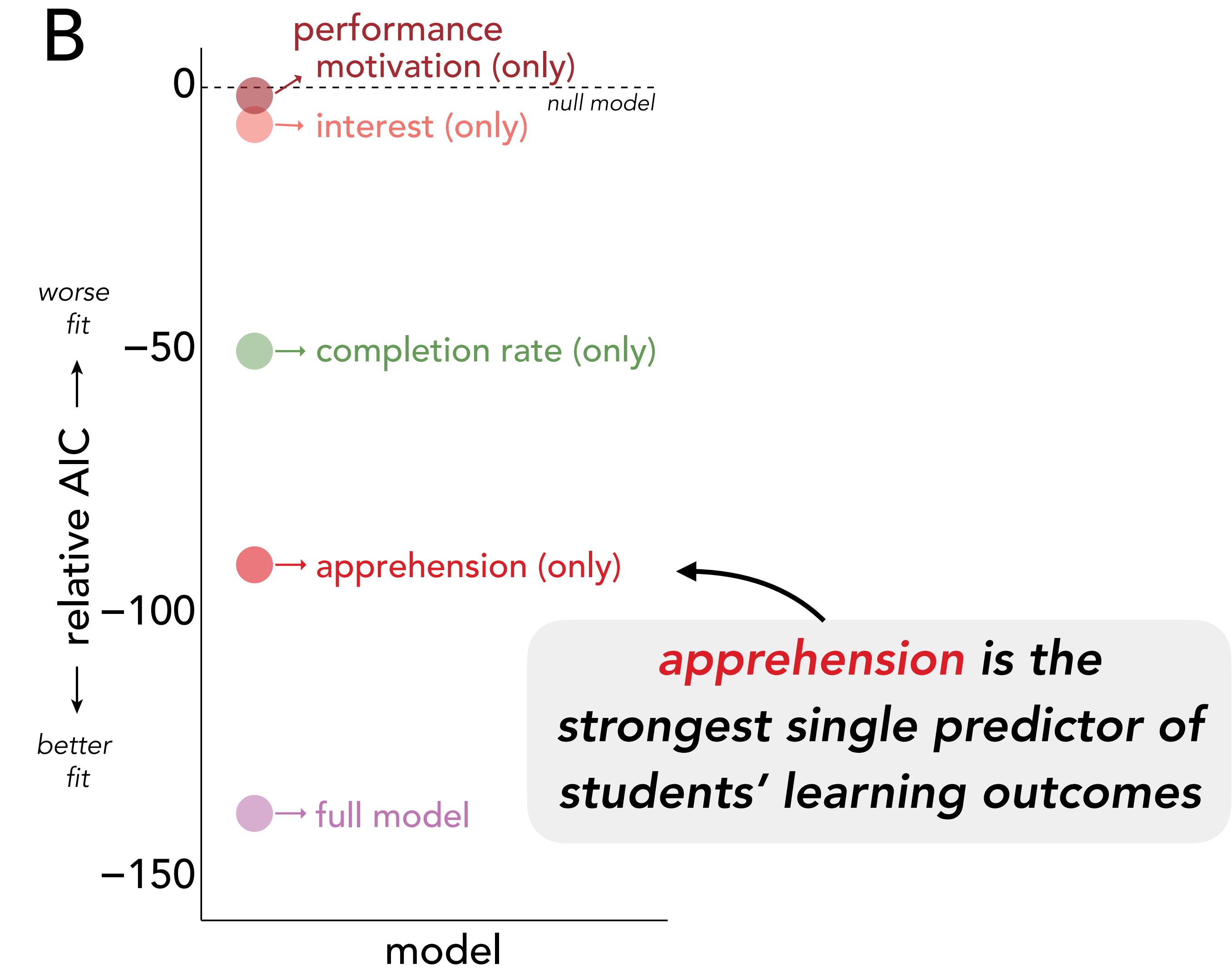
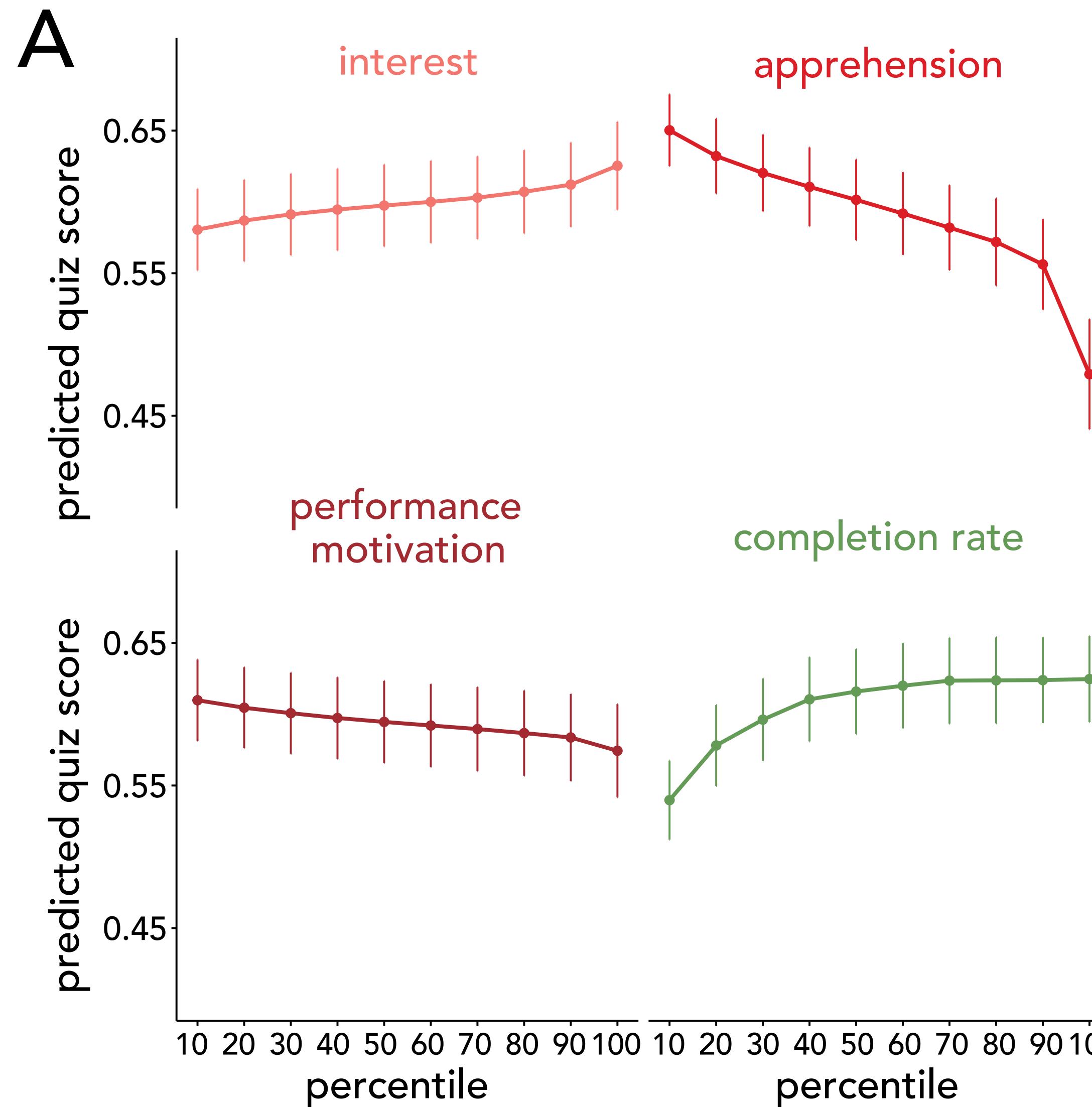
1

How well do student **attitudes** & **engagement** predict learning?

2

How well do student **attitudes** & **learning outcomes** predict  
**engagement**?

# How well do student attitudes & engagement predict learning?



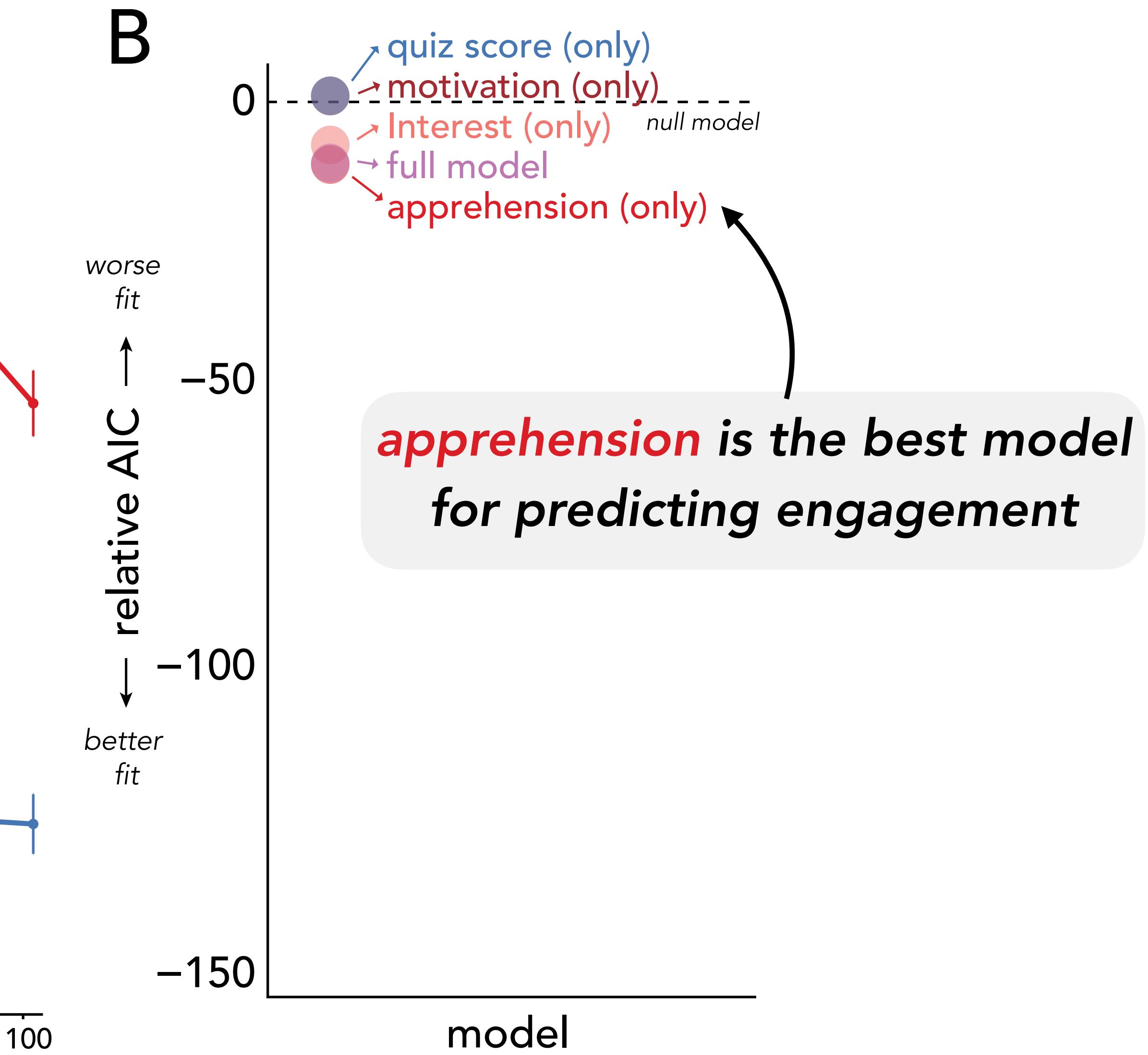
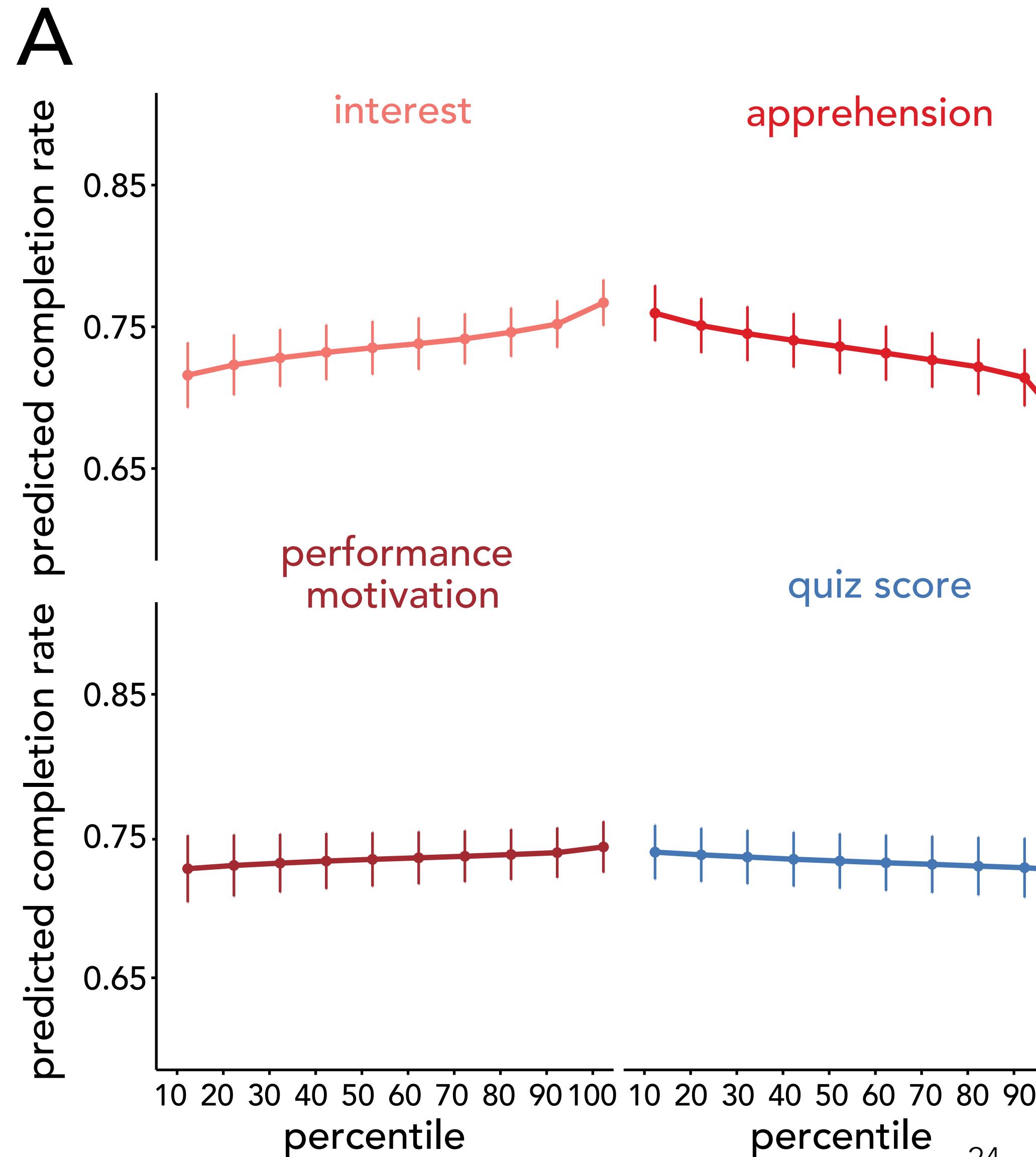
1

How well do student **attitudes** & **engagement** predict learning?

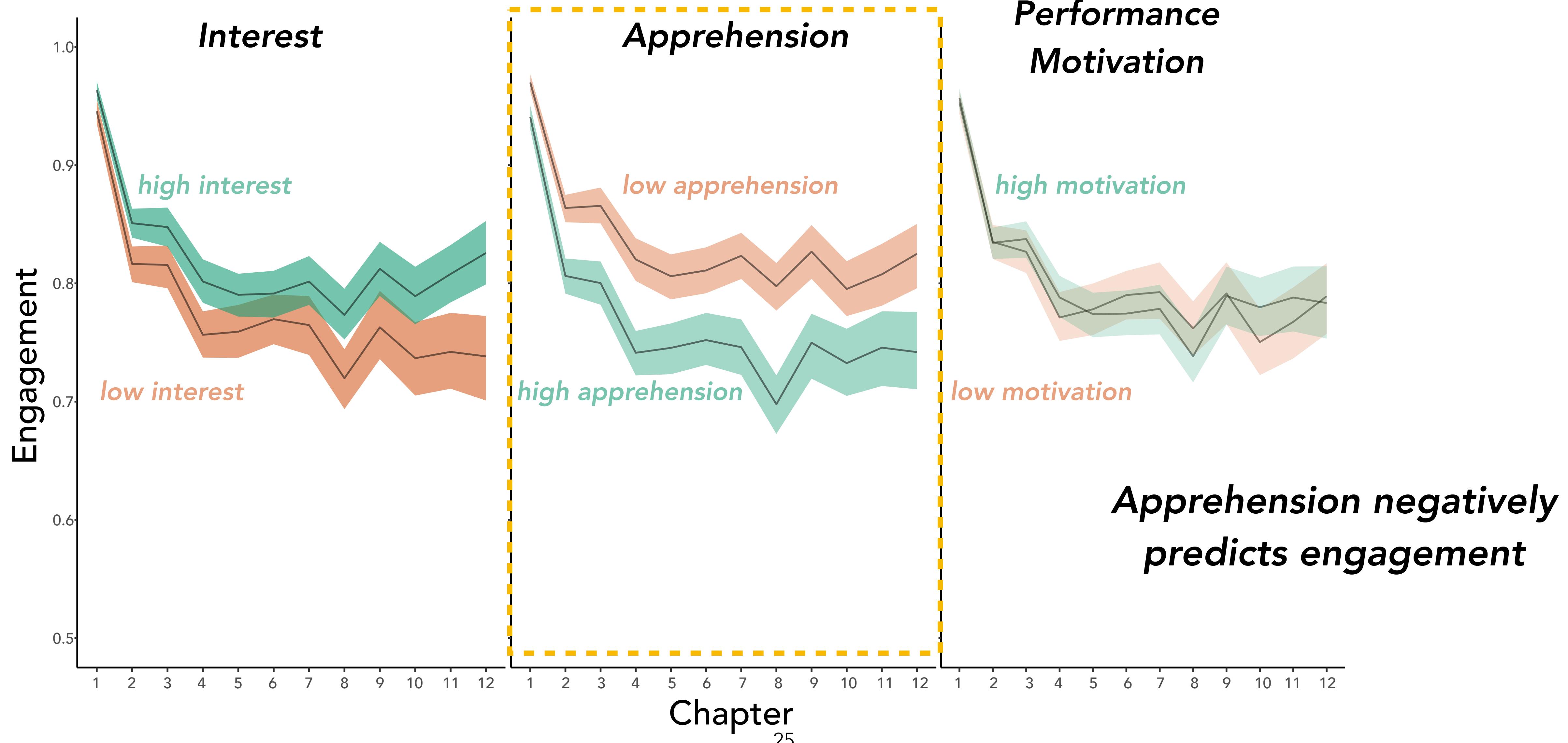
2

How well do student **attitudes** & **learning outcomes** predict  
**engagement**?

# How well do student attitudes & learning outcomes predict engagement?



# A closer look on how attitudes predict student engagement:



1

## How well do student **attitudes** & **engagement** predict **learning**?

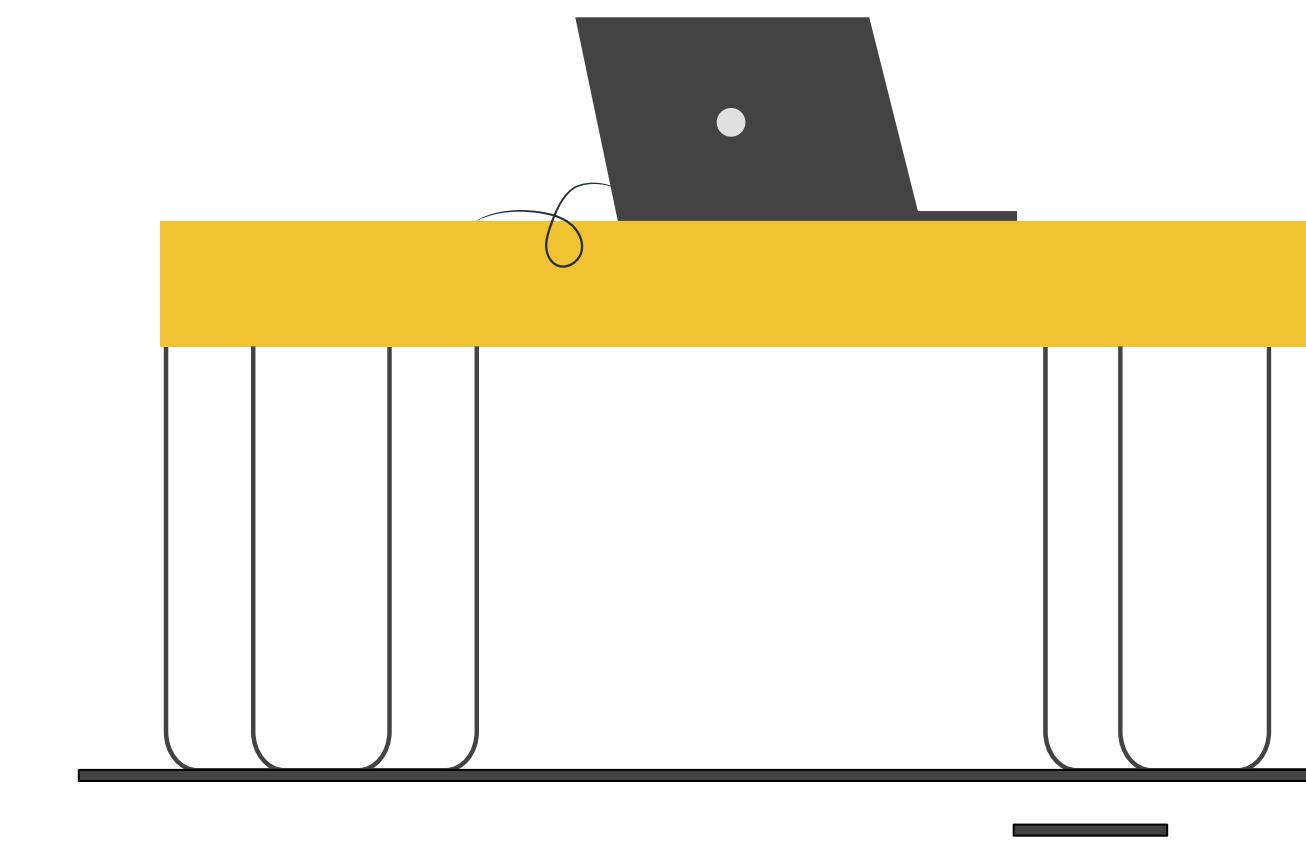
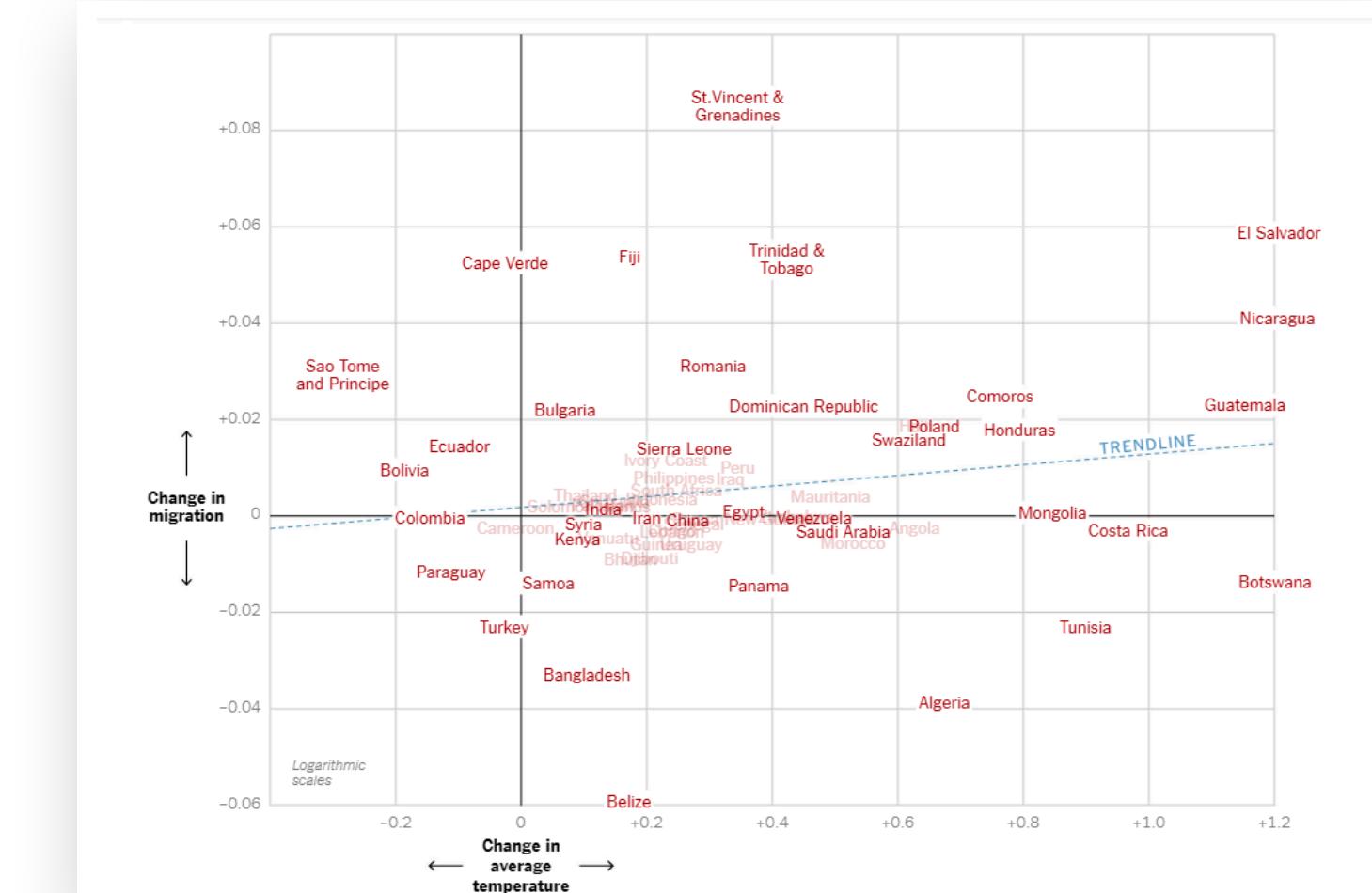
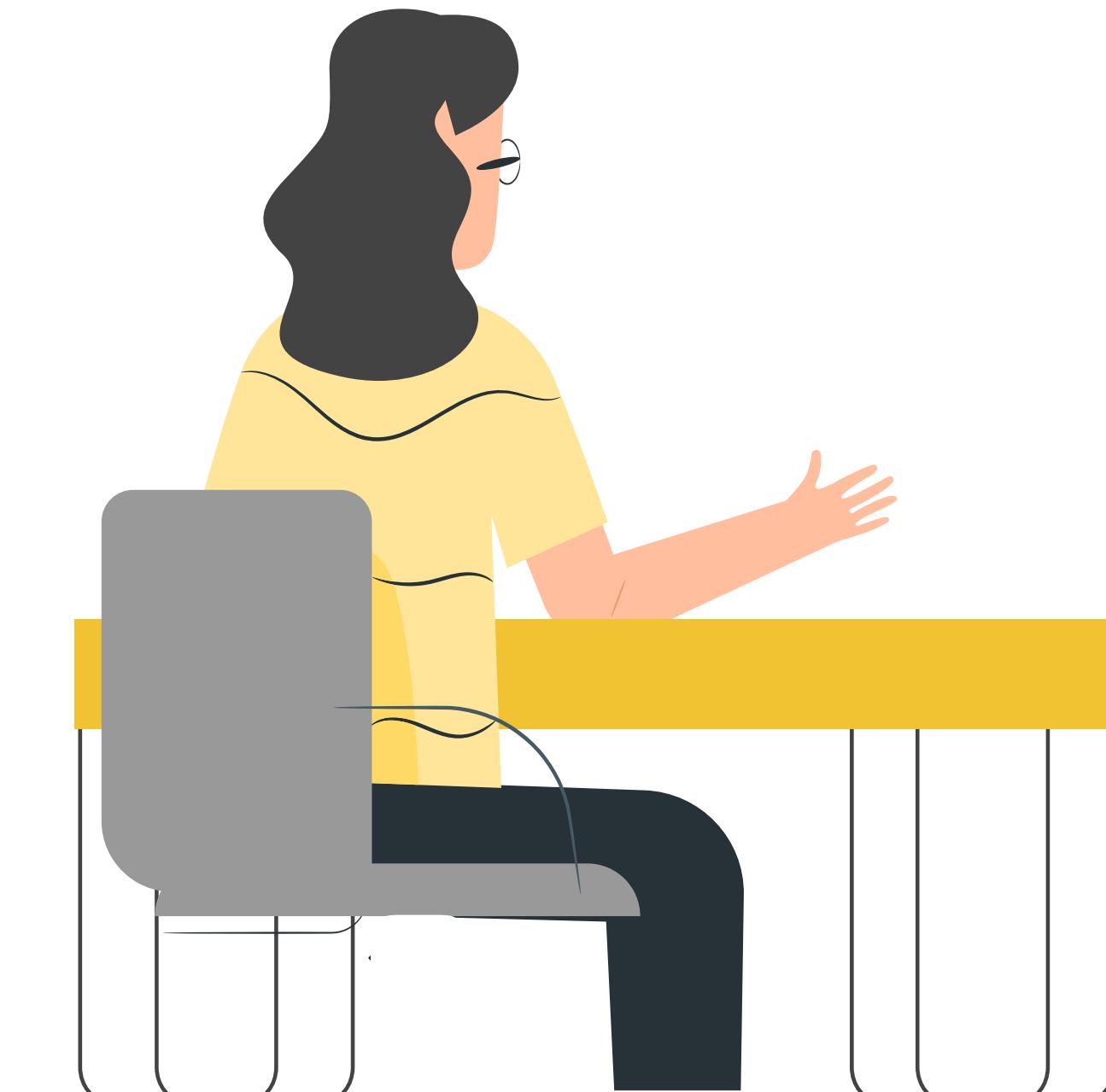
*The attitudes, expectations, and motivation that students bring to the course have an impact on how they engage, and their learning outcomes*

2

## How well do student **attitudes** & **learning outcomes** predict **engagement**?

*Students with greater levels of apprehension towards the material regulate their learning behavior differently.*

# Towards interventions for equitable learning in data science courses



*Fine-grained measures of students attitude and behaviors can be useful indicators for teachers*

# Thank you! Questions?



Hannah Lloyd



Erik Brockbank



Adam Bear



Judy Fan



cognitive tools lab